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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/812,412	03/30/2004	Steve Wang	543822005300	1275

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EXAMINER

HA, NATHAN W

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 01/06/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/812,412

Applicant(s)

WANG ET AL.

Examiner

Nathan W. Ha

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 October 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-9 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-7 and 9 rejected under 35 U.S.C. 103(a) as being unpatentable over Akatsu et al. (US 6,967,136, newly cited, herein after Akatsu) and in view of Chudzik et al. (2004/0063277, previously cited, hereinafter, Chudzik.)

In regard to claim 1, in figs. 6-10, Chudzik discloses a method for producing a deep trench capacitor semiconductor substrate, comprising:

providing a first trench 500 (fig. 6) in the semiconductor substrate 205;

oxidizing the semiconductor substrate in the first trench for providing an oxidized silicon layer 655;

depositing a conformal layer 660 in the first trench;

removing horizontal regions of the conformal oxide layer and the oxidized silicon layer (figs. 6);

providing a second trench 720 underneath the first trench;

increasing a width of the second trench to a widened second trench for providing a bottle structure (fig. 7);

depositing a dielectric layer in the widened second

trench (col. 9, lines 49-54); and

filling the widened second the trench with a conductive material (see col. 9, lines 53-55.)

Akatsu further discloses that the layer 660 is made of a dielectric material such nitride layer. However, aluminum oxide may be used to replace the nitride layer since aluminum had higher dielectric constant which is a factor that provides higher capacitance. For instance, Chudzik discloses an analogous trench capacitor using aluminum as a dielectric layer 400 as a high-k dielectric layer, aluminum oxide.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use a well known high-k dielectric material as taught by Chudzik in order to take the advantages as mentioned above.

In regard to claims 2, wherein after increasing the width of the second trench to the widened second trench a doping the semiconductor substrate in the widened second trench is provided for providing a first electrode (see Chudzik's fig. 5 and section [0011], and Akatsu's fig. 9.)

In regard to claims 3 and 6, the polysilicon is deposited in the wider trench after widened it (Chudzik's section [0013].)

In regard to claim 4, the widening the trench by using a hemispherical grain polysilicon is well known in the art of making silicon substrate (Chudzik's see section [0008].)

In regard to claim 5, Chudzik further discloses:

depositing the silicon nitride and oxidize the layer in a high temperature process (oxidation process), see section [0010].

In regard to claim 7, the aluminum layer is Al_2O_3 (see Chudzik's section [0010].)

In regard to claim 9, the increasing the width of the second trench for providing the bottle structure is provided by RIE etching process (Chudzik's section [0011].)

3. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Akatsu and Chudzik as applied to claims 1-7 and 9 above.

In regard to claim 8, the above embodiment of Akatsu and Chudzik does not expressly mention using wet etching in widen the second trench. But Chudzik teaches that using a wet etching process to expose portion of layer 510. It also should be noted that wet etching is well known in the art of making semiconductor devices since the thickness of the etched layer can be controlled and the the quality of the dielectric layer can be improved (see section [0012].)

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use a well known etching process as taught by Chudzik in order to take the advantages as mentioned above.

Response to Arguments

4. Applicant's arguments with respect to claims 1-9 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nathan W. Ha whose telephone number is (571) 272-1707. The examiner can normally be reached on M-TH 8:00-7:00(EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read "Nathan W. Ha". The signature is fluid and cursive, with the first name "Nathan" being the most prominent part.

Nathan Ha
January 3, 2006